

1 Introduction



Northern Puget Sound near Anacortes and Mt. Baker. | Shutterstock.com | Natalia Bratslavsky

This is the ninth edition of the *Puget Sound Update*, a report first published by the Puget Sound Action Team in 1990. The *Puget Sound Update* summarizes the condition of Puget Sound as measured by ongoing monitoring and research activities of the Puget Sound Assessment and Monitoring Program (PSAMP). This report also includes research findings from a variety of additional monitoring and research efforts, conducted by local governments, research institutions, Tribes, state and federal agencies, and citizen monitoring groups. The purpose of the *Puget Sound Update* is to communicate the scientific understanding of the Puget Sound ecosystem, and the consequence of human and natural stressors on the Sound's physical and biological resources.

Since the previous edition of the *Puget Sound Update* was released in 2002, considerable attention has been focused on the condition of the nation's marine waters. The findings recently reported by the U.S. Commission on Ocean Policy (in 2004) and the Pew Oceans Commission (in 2003) suggest that many of the nation's estuary, bays, and deep ocean waters are under severe stress from human activities, including over-harvest of marine species for consumption, development along sensitive coastal areas, and inputs of toxic contaminants from industry and urban runoff. In Puget Sound, Governor Chris Gregoire has placed Puget Sound high on her list of priorities by setting a goal of restoring Puget Sound's health by 2020. The roadmap for achieving this goal was presented to the Governor in the fall of 2006 by a group of high-level policy-makers, community leaders, and stakeholder representatives known as the Puget Sound Partnership.

Oceans and Human Health – A Context for this Report

Oceans are critical components of the earth's ecosystems and are explicitly linked with human health in a variety of ways. The oceans are the source of most of the world's biodiversity, as well as the largest producers of biomass. Oceans generate weather patterns, provide food for human populations, and play key roles in controlling greenhouse gases. However, these large bodies of water are

also repositories for a wide range of compounds released into our waters and atmosphere, particularly near coastal urban centers. Releases of natural and man-made compounds as a result of human activities can seriously impact the oceans' ecosystems, which, in turn, can affect the health of the living marine resources on which humans rely. It is important to increase our understanding of these interactions in order to identify, predict, and lessen serious impacts to public health.

Humans are top-level consumers of marine fish and seafood and, as such, can be exposed to man-made toxics via consumption of contaminated marine organisms. These toxic compounds include industrial chemicals (e.g., PCBs, flame retardants), pesticides (e.g., DDTs), metals, and many other new contaminants of concern (e.g., pharmaceuticals, personal care products). Exposure to these toxic contaminants has been linked to immune suppression, reproductive failure, and other biological effects in mammals. Relatively high levels of these compounds occur in urban coastal environments. Humans can also be exposed to a variety of naturally occurring pathogens, capable of causing human disease, that exist in the marine environment in fish and shellfish. Human activities can also exacerbate the pathogens occurrences; many pathogens in estuaries and oceans are a result of human activities, including poor sanitation, inadequate water treatment practices, and agricultural runoff. Thus, the transmission of infectious disease and exposure to natural and man-made toxics are some of the current pathways by which ocean factors can negatively impact the health of humans.

Oceans may also provide information about current and potential impacts to public health, through examination of how toxins and pathogens affect marine organisms. Sentinel species, such as marine mammals, birds, and fish, can serve as important indicators of the status and trends in ocean health, and the observation and study of appropriate marine organisms can lead to a better understanding of potential public health risks.

The Puget Sound Assessment and Monitoring Program

When the first edition of the Puget Sound Update was published, PSAMP had been in existence only two years, and the report summarized only one or two years' worth of data. Now, 16 years later, PSAMP is one of the country's longest-running marine monitoring programs, with trend information from many components extending back to the first year of data collection. PSAMP has become a model program for monitoring the status and trends of many national and international estuaries and coastal areas.

The agencies and institutions that participate in PSAMP and their areas of focus include:

- Washington State Department of Ecology (Ecology)
Marine sediment, marine water, and fresh water
- Washington State Department of Fish and Wildlife (WDFW)
Contaminants burdens in marine fish, population abundance of fish, marine birds, and mammals
- Washington State Department of Natural Resources (DNR)
Nearshore habitat, kelp and eelgrass
- Washington State Department of Health (DOH)
Nearshore marine water quality, shellfish growing areas
- King County Department of Natural Resources and Parks (KC DNRP)
Marine water, marine sediments, and shellfish
- U.S. Fish and Wildlife Service (USFWS)
Bird abundance and contaminants

- Northwest Fisheries Science Center (NFSC), National Oceanic and Atmospheric Administration
Contaminant burdens in marine fish, toxicology of contaminants
- University of Washington, Applied Physics Laboratory (UW APL)
Marine water, modeling
- U.S. Environmental Protection Agency (EPA)
Technical and programmatic support, sponsorship of targeted research studies
- Puget Sound Action Team (PSAT)
Coordination of PSAMP activities and management

Scope and Structure of this Report

The *Puget Sound Update* is a technical report that integrates results of PSAMP and other scientific activities in Puget Sound focused on marine life and nearshore habitat, marine and freshwater quality, and toxic contamination. The report contains summary information on status and trends, as well as findings from focused studies, but does not include methodologies and analytical details found in agency reports or peer-reviewed publications. The target audience for this report is resource managers, scientists, decision-makers, and interested citizens.

The goal of the *Puget Sound Update* is to provide a clear summary of monitoring and research findings so that readers can evaluate the current condition of Puget Sound as well as understand how the water quality, sediments, and biological resources have changed over time. It is also expected that *Puget Sound Update* findings will be integrated into management activities aimed to protect, conserve, and restore Puget Sound's ecosystem.

This edition of the *Puget Sound Update* is organized into four main topics:

- Biological Resources
- Physical Environment and Habitat
- Toxic Contaminants
- Nutrients and Pathogens

The breadth of spatial coverage in each chapter encompasses the greater Puget Sound Region, including Hood Canal and the San Juan Archipelago. To develop a common basis for monitoring and reporting, PSAMP has delineated six main basins in Puget Sound. From the north, the basins are: San Juan Archipelago, the Strait of Juan de Fuca, North Puget Sound (Whidbey Basin and Admiralty Inlet), Central Puget Sound, Hood Canal, and South Puget Sound (Figure 1-1). In some basins, the boundaries coincide with sills; for others, the demarcation is arbitrary. The report also includes data from studies where the range of sampling sites extend into the Strait of Juan de Fuca, the outer Washington Coast, or the Strait of Georgia.

Each chapter begins with an introduction to the topic and lists key findings from the information within the chapter. In some instances, topics are shared between chapters, in which case, cross-references are noted within the text. The status and trends of each topic are summarized and the ecological and human health implications of the findings are reported, when information was available. Each chapter concludes with recommendations that summarize data gaps and research needs, and provides recommended targets or goals for consideration by management when planning future research and monitoring activities.

Figure 1-1. Puget Sound and the six PSAMP basins referred to throughout this report.

